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9. — INTENSITIES OF 9.4 μ AND 10.4 μ CO_2 BANDS

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The intensities of the 9.4 μ and 10.4 μ CO_2 bands have been computed theoretically using, as the basis of our calculation, the line profiles at the centers of these bands published by Migeotte, Neven, and Swensson (1957). The band intensity values thus obtained are as follows :

9.4 μ band — 0.0180 cm^{-2}-$atm.^{-1}$ at 265°K
10.4 μ band — 0.0098 cm^{-2}-$atm.^{-1}$ at 265°K

The ratio of the two band intensities is 1.84 which is closer to the value of 1.7 given by Kostkowski (1955) than to 2.4 reported by Penner (1959).

The 9.4 μ and 10.4 μ CO_2 bands are extremely weak, and for the amount of CO_2 present in the earth's atmosphere ($\sim$ 0.03 %) they do not play any significant role in the radiation processes within the terrestrial atmosphere. For this reason theoretical and experimental investigations of these bands have been rather limited. Also the two results available in the literature (Penner, 1959 and Kostkowski, 1955) differ rather significantly from each other.

For the purposes of studying radiative properties of the atmospheres of the other planets, Venus and Mars for example, where the amount of CO_2 in the atmosphere may be greater than in the earth's by several orders of magnitude, these bands do become important (Jastrow and Rasool, 1963). Therefore, in the absence of generally accepted values of the intensities of 9.4 μ and 10.4 μ bands, we have attempted to estimate them independently.

The method used is as follows : The solar infrared spectrum published by Migeotte et. al. (1957) contains many lines at the center of the 9.4 μ and 10.4 μ bands due to absorption by CO_2

present in the earth's atmosphere. Measuring the total absorption within these lines and applying the Ladenburg and Reiche (1911) solution we calculate the intensities of lines in the P and R branches of the bands. The half width of the lines was assumed to be 0.09 cm^{-1} at NTP, and the amount of CO_2 in the absorption path was determined on the assumption that the total CO_2 in the earth's atmosphere is 2.40 m-atm. These line intensity values were then used to obtain a mean value of the band intensity using the classical relation (see, for example, Goody, 1963).

Internal consistency in the band intensity calculations was achieved when the effective temperature of the atmosphere above Jungfraujoch observing station was assumed to be 265°K. This is $\sim$ 6°K lower than the recorded surface temperatures during these observations.

In the following table we give the band intensity values determined by the method mentioned and the values given by the other authors.

Intensities in cm^{-2}-atm^{-1} of CO_2 *Bands at* 9.4 μ *and* 10.4 μ

	9.4 μ (S′)	10.4 μ(S″)	T	S′/S″
This work	0.0180	0.0098	265°K	1.8
Kostkowski (1955)	0.0465	0.0281	329° K	1.7
Penner (1959)	0.0532	0.0219	297° K	2.4

The band intensity values given by Kostkowski, when reduced to 265°K, compare fairly well with our results, but those of Penner, especially of the 9.4 μ band, are significantly higher than ours.

I wish to thank Professor R. M. Goody of Harvard University for suggesting this method of calculation.

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